Administrative Report

Proposed updates to the *Australian Drinking Water Guidelines*

- Ammonia chemical fact sheet
- Nickel chemical fact sheet
- Chlorine dioxide, chlorite, chlorate chemical fact sheet
- Ongoing edits and corrections

Public Consultation Draft

April 2026

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Administrative Report: Proposed updates to the *Australian Drinking Water Guidelines* (April 2026) (public consultation draft)

Summary

The National Health and Medical Research Council (NHMRC) has prepared several draft updates to the *Australian Drinking Water Guidelines* (the Guidelines) for public consultation, which includes:

- revised chemical fact sheets for ammonia, nickel and chlorate
- ongoing edits and corrections to the Guidelines, including:
    - amendments to Chapter 5 (*Microbial Quality of Drinking Water*)
    - amendments to Appendix 3 (*Derivation of microbial treatment targets for enteric pathogens)*
    - updates to referenced ISO and AS/NZS Standards.

This document summarises the guideline development process undertaken for these proposed updates.

Background

NHMRC issues guidelines under section 7(1) of the *National Health and Medical Research Council Act 1992* (the NHMRC Act). NHMRC maintains the Guidelines through a rolling review process to ensure they provide an up-to-date evidence-based framework for the management of drinking water quality. The Guidelines contain information and guidance on the physical, microbial, chemical and radiological quality of drinking water.

The Guidelines form part of the National Water Quality Management Strategy, an Australian Government initiative in partnership with state and territory governments. The Guidelines are intended as a consistent source of authoritative guidance on drinking water quality management and allow states and territory governments to adapt the guidance to local needs.

Chemical fact sheet reviews

Part V of the Guidelines contains fact sheets for over 200 chemicals that are typically present in Australian drinking water supplies. The fact sheets contain information on relevant aspects of the chemicals in drinking water, including but not limited to:

- health-related advice (e.g. a health-based guideline value and/or public health advice, health considerations, exposure information and risk summaries)
- supporting information (e.g. guidance on analytical measurements or sampling, water treatment and risk management options).

Since the current version of the Guidelines was published in 2011, updates to specific sections of the Guidelines, including chemical fact sheets, have been undertaken as part of a 'rolling review' process. Suggestions for potential updates or the development of new advice are considered in

response to new evidence, stakeholder needs and available resources. Updates are prioritised and delivered with advice from the Water Quality Advisory Committee (the Committee).

NHMRC worked with previous terms of the Committee to prioritise the review of selected chemical fact sheets in the Guidelines through the development of screening criteria. This screening process, together with consultation with the former enHealth Water Quality Working Group (now the enHealth Water Quality Expert Reference Panel), resulted in agreement on priority chemicals and disinfection by-products for review, including ammonia, nickel and chlorate.

Contracted evidence reviews of existing guidance and guidelines, for ammonia, nickel and chlorate were undertaken in 2021 – 2022 (see **Contracted Evidence Reviews** section).

Methodological framework

As part of a broader organisational effort to improve the processes used to develop NHMRC guidelines, NHMRC has designed a streamlined methodological framework (the Framework) to guide the rolling revision of chemical fact sheets in the Guidelines.

The Framework is intended to provide a greater consistency and alignment with the 2016 *NHMRC Standards for Guidelines* and international best practice in evidence review methods and guideline development. It is also intended to:

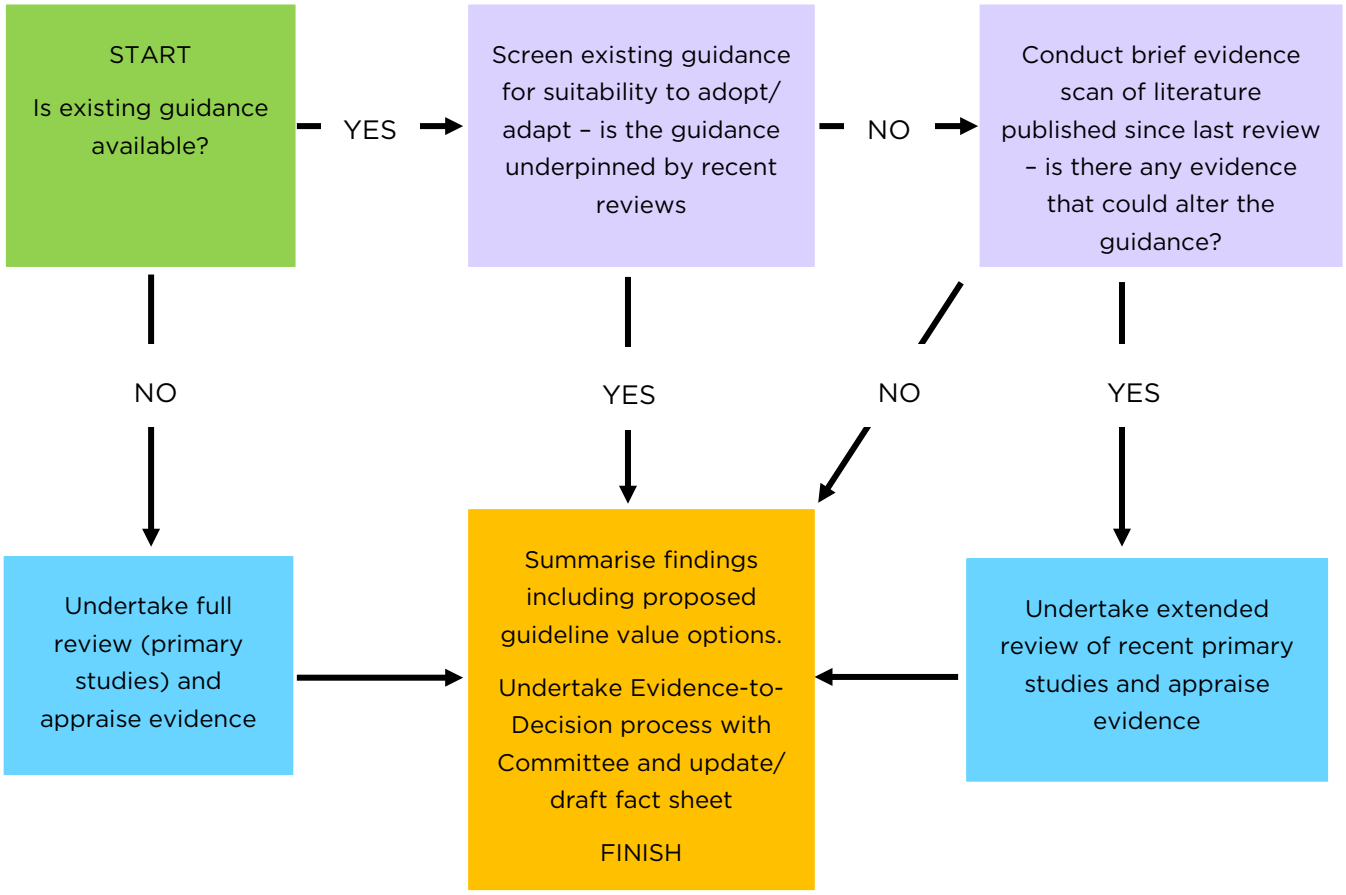
- make efficient use of limited project resources (such as funding, project team and Committee capacity)
- make greater use of recent reviews undertaken by other jurisdictions and reduce duplication of effort
- minimise the timeframes required to undertake a chemical fact sheet review (depending on whether recent reviews are available)
- allow a more responsive approach to changes in international guidance
- allow more reviews to be undertaken in-house using templates and tools
- help inform future funding bids by identifying chemicals that may require additional funding for contracted evidence reviews.

The Framework provides the option to undertake different levels of review depending on the available evidence (see **Figure 1**). The Framework outlines a staged approach that preferences a transparent adopt/ adapt process for evaluating existing health advice (such as international health-based guideline values) in the first instance instead of undertaking a more comprehensive review of primary studies. Other features of the Framework include:

- the option to undertake an evidence scan to check for emerging evidence of concern since the existing guideline was published (particularly if it was not reviewed recently)
- the option to undertake reanalysis of key study findings from existing guidelines if appropriate and advised by the Committee
- the flexibility to customise the review process for each chemical using template research protocols for the different levels of review.

Existing guidance for a chemical may not always be available or appropriate to use for the Australian context. In these cases, a full review of recent primary studies is required, and additional resources will be needed to undertake the review.

Figure 1. Simplified decision tree for undertaking evidence evaluation reviews using the Framework



Text alternative of Figure 1

Start – Is existing guidance available?

1. Yes – Screen existing guidance for suitability to adopt/adapt – is the guidance underpinned by recent reviews?
   a) Yes - Summarise findings including proposed guideline value options. Undertake Evidence-to-Decision process with Committee and update/draft fact sheet. FINISH
   b) No – Conduct brief evidence scan of literature published since last review – is there any evidence that could alter the guidance?
      i. Yes – Undertake extended review of recent primary studies and appraise evidence
         (I). Summarise findings including proposed guideline value options. Undertake Evidence-to-Decision process with Committee and update/draft fact sheet. FINISH
      ii. No - Summarise findings including proposed guideline value options. Undertake Evidence-to-Decision process with Committee and update/draft fact sheet. FINISH
2. No – Undertake full review (primary studies) and appraise evidence
   (II). Summarise findings including proposed guideline value options. Undertake Evidence-to-Decision process with Committee and update/draft fact sheet. FINISH

Guidance development process

Key steps of the overall process for developing the proposed updates to the chemical fact sheets are summarised below:

1. Scoping
   - NHMRC prioritises chemical fact sheet reviews, informed by advice from the Committee and jurisdictions
   - The Committee provides advice on the scope of the review, including proposed review methods
   - Approval to commence work is sought from NHMRC CEO or Executive Director.

2. Evidence Review
   - An independent contractor is engaged to undertake an evidence review to inform the fact sheet review
   - A research protocol on the evidence review is drafted and reviewed by the Committee
   - Once the research protocol is approved, the evidence review is initiated
   - The Committee reviews and provides feedback on the draft evidence review reports
   - The evidence review reports are finalised after the independent contractor addresses feedback from the Committee.

3. Draft Guidance
   - The Committee considers proposed guideline options informed by the evidence review and undertakes an Evidence-to-Decision process to determine the guideline recommendation, such as a preferred guideline value
   - NHMRC and the Committee or members of the Chemical Subgroup draft new or updated guidance in the relevant chemical fact sheet based on the Evidence-to-Decision process and evidence review
   - The EnHealth Water Quality Expert Reference Panel is consulted on the draft guidance, with feedback addressed and revisions made to guidance as required.

4. Public Consultation
   - The Committee advises on releasing the draft guidance for public consultation
   - NHMRC Council recommends public consultation, and the NHMRC CEO approves release
   - NHMRC releases the draft guidance for public consultation (minimum 30-day period).

5. Revision of Guidance
   - NHMRC and the Committee review the public submissions and revise the guidance as needed
   - The EnHealth Water Quality Expert Reference Panel is consulted on the revised guidance.

6. Final Guidance
   - The Committee advises on finalisation and publication of the guidance in the Guidelines
   - NHMRC Council advises the NHMRC CEO to publish the updated guidance
   - The NHMRC CEO approves publication of the guidance and a revised version of the Guidelines is published on the NHMRC website.

Contracted evidence reviews

SLR Consulting Australia was contracted from 2021 to 2022 to undertake reviews of existing guidance and guidelines for a number of chemicals, including ammonia and nickel. The scope of these reviews was limited to searching, selecting and reviewing suitable existing guidance/guidelines for potential adoption/adaption in Australia.

CDM Smith was contracted from 2021 to 2025 to undertake a review of existing guidance and guidelines for several disinfection by-products, including chlorate. The chlorate evidence review was limited to searching, selecting and reviewing suitable existing guidance/guidelines for potential adoption/adaption in Australia.

Both SLR Consulting Australia and CDM Smith applied the methodological framework when conducting the evidence reviews, as noted below by:

- customising a draft research protocol template provided by NHMRC for each chemical. The research protocol outlines the review scope and parameters for searching, selecting and appraising the evidence
- confirming any amendments to the draft research protocol with the Committee at a meeting. The Committee confirmed the research questions and other technical details required for the reviews
- finalising the research protocol (and any amendments) and seeking approval from NHMRC before commencing the review
- undertaking a review of evidence for each chemical as per the Framework (Figure 1).
- if recently published guidance/guidelines are available, assessing the methods used by the organisation/agency with an Assessment Tool provided by NHMRC that assesses administrative and technical criteria to determine if they are suitable to adopt/adapt
- undertaking an evidence scan to support the development or update of supporting information in each chemical fact sheet
- deriving candidate guideline options for each chemical in drinking water using Australian assumption values and uncertainty factors
- presenting the findings of the review in an Evidence Evaluation and Technical Report for Committee consideration.

The reviewers did not make recommendations for health-based guideline values but provided candidate guideline options for consideration by the Committee. These options were based on:

- existing guidance/guidelines that were found suitable to adopt/adapt to the Australian context, with a critical discussion of the underlying key toxicological studies used by each agency to derive their guidance/guidelines
- key toxicological studies (animal or human) that the reviewer found to be of sufficient study quality to derive a health-based guideline value.

Further details on how each evidence review was undertaken is provided in the Research Protocols and Evidence Evaluation Reports for each chemical.

Evidence-to-Decision process

Evidence reviews provide a comprehensive summary of the evidence but do not include recommendations (e.g. health-based guideline values). The term 'decision' is used to mean the resulting judgement of the evidence made by NHMRC and the Committee. NHMRC, with advice from the Committee, developed Evidence-to-Decision tables for each chemical based on the results of the available Evidence Evaluation Reports and relevant criteria/domains from existing Evidence-to-Decision frameworks (e.g. GRADE and WHO-INTEGRATE frameworks as outlined in Alonso-Coello *et al*. (2016) and Rehfuess *et al*. (2019)).

The Evidence-to-Decision tables (see **Appendix A**) helped to inform Committee discussion and support transparent consideration of the findings from the evidence reviews undertaken by the reviewer (e.g. evidence profiles for candidate guideline values). While the certainty of the evidence for the different guideline options typically determines which guideline values are selected for each chemical (ammonia, nickel and chlorate), other public health considerations such as consumer values and preferences, equity, feasibility and resource impacts are also noted in the discussions and are noted if relevant in decision-making.

Candidate guideline options for ammonia, nickel and chlorate in drinking water were reviewed and considered by the Chemical Subgroup (a subgroup of the Committee) before discussing and reaching consensus on the preferred options at a follow up Committee meeting. The process for selecting potential health-based guideline values for ammonia, nickel and chlorate are summarised below.

<u>July 2025</u>

- At the July Chemical Subgroup Meeting, Members discussed the findings of the ammonia evidence review by SLR Consulting, which identified no information in reviews from different jurisdictions nor in the evidence scan that indicated a reason to derive a health-based drinking water guideline value for ammonia.
- Chemical Subgroup Members agreed that maintaining the current aesthetic guideline value for ammonia at 0.5 mg/L based on corrosion of copper pipes and fittings was appropriate, and setting a health-based guideline value was not required as there were no health effects of concern at levels typically observed in Australian drinking water supplies.

<u>September 2025</u>

- At the September Chemical Subgroup Meeting, Members discussed the findings of the nickel evidence review by SLR Consulting and advised candidate guidance/guideline values by EFSA be considered for adoption/adaption to the Australian context. This would result in an increased drinking water guideline of 0.05 mg/L for nickel.

<u>November 2025</u>

- At the November Committee Meeting, Members discussed the Chemical Subgroup recommendation to retain the current aesthetic guideline value for ammonia of 0.5 mg/L and agreed to it.
- Members also discussed the findings of the nickel review and advised to increase the drinking water health-based guideline value to 0.05 mg/L (rounded) for nickel.
- Members discussed the findings of the chlorate review by CDM Smith and advised that further discussion is needed on the technical feasibility of guideline options, including

consideration of an appropriate relative source contribution and uncertainty factors for guideline derivation.

- At a subsequent Chemical Subgroup Meeting, Members recommended the candidate guideline value by US EPA be considered for adoption/adaption, resulting in the establishment of a health-based guideline value of 0.8 mg/L for chlorate in the Australian context.
    - The derivation of the health-based guideline value of 0.8 mg/L included a relative source contribution (RSC) of 80%, consistent with a number of other agencies including the WHO.

December 2025

- At the December Committee Meeting, Members confirmed their preference to maintain the current aesthetic guideline value of 0.5 mg/L for ammonia; raise the health-based guideline value from 0.02 mg/L to 0.05 mg/L for nickel; and establish a health-based guideline value of 0.8 mg/L for chlorate.

Drafting of guidance

The NHMRC Project Team updated the chemical fact sheets for ammonia, nickel and chlorate (within the broader chlorine dioxide, chlorite and chlorate fact sheet) based on discussions with the Committee and the outcomes of the evidence-to-decision process. In addition, a number of consequential edits to other sections of the Guidelines were proposed to ensure consistency across the Guidelines and alignment with any proposed changes in health-based and/or aesthetic guideline values.

The Chemical Subgroup reviewed the draft guidance and provided feedback before Committee review and discussion at a full Committee meeting.

The '**Timeline for development of draft Guidelines'** section provides an overview of the guideline development process.

Ongoing edits and corrections to the Guidelines

In December 2024, NHMRC published minor consequential amendments in the Guidelines to align with updated guidance on microbial quality of drinking water that was released in September 2022. During this process, further potential amendments were identified by the Committee, the enHealth Water Quality Expert Reference Panel and Water Services Association Australia. However, these amendments were deemed out of scope for the December 2024 update, as they required further discussion and/or public consultation.

NHMRC has revisited these potential amendments along with other possible updates, including:

- further revisions to Chapter 5 (*Microbial quality of drinking water*)
- amendments to Appendix 3 (*Derivation of microbial treatment targets for enteric pathogens*) as a consequence of revisions to Chapter 5
- updates to AS/NZS and ISO standards
- other text amendments (such as consistent terminology, definitions, calculations, references, footnotes).

NHMRC drafted an initial set of potential amendments, based on those previously identified, and worked with Microbial Subgroup Members to assist with this work, before seeking feedback from the larger Committee. Feedback was also sought from the enHealth Water Quality Expert Reference Panel prior to final review by the Committee and advice on releasing the draft guidance for public consultation. A timeline of the guideline development process, including key meetings where the project was discussed, is provided below.

Timeline for development of draft guideline updates

Table 1: Timeline development of draft guideline updates

Key guidance development steps	Timeframes
SLR Consulting Australia contracted to undertake review of existing guidance and guidelines for prioritised chemicals, including ammonia and nickel. Draft reports reviewed by the Committee and comments addressed before final reports provided to NHMRC.	July 2021 – June 2022
CDM Smith contracted to undertake review of existing guidance and guidelines for disinfection by-products, including chlorate.	July 2021 – November 2021
CDM Smith submitted the final evidence review on chlorate (with an assessment of guidance, guidelines, and studies published up to 2021).	June 2025
NHMRC drafted revised ammonia fact sheet with advice from the Chemical Subgroup. Chemical Subgroup discussed the evidence review for ammonia, including consideration of guideline options and evidence-to-decision process.	June - July 2025
NHMRC drafted revised nickel and chlorate fact sheets with advice from the Chemical Subgroup. Chemical Subgroup discussed evidence review for nickel and chlorate, including consideration of guideline options and evidence-to-decision process.	August - September 2025
NHMRC drafted an initial set of potential amendments (regarding ongoing edits and corrections), based on those previously identified, and worked with Microbial Subgroup members to assist with this work.	August - October 2025
The Committee discussed the draft chemical fact sheets, and the recommended guideline options by the Chemical Subgroup for ammonia, nickel, and chlorate; reaching a consensus on guideline values for ammonia and nickel. The Committee was updated on the progress of the ongoing edits and corrections to the Guidelines.	November 2025

Key guidance development steps	Timeframes
Chemical Subgroup reviewed the draft chemical fact sheets, and further discussed the guideline options and evidence-to-decision process for the chlorate guideline value.	November 2025
The Committee reached a consensus on the chlorate guideline value, and reviewed the draft chemical fact sheets for ammonia, nickel and chlorate. The Committee advised on the draft ongoing edits and corrections, with feedback actioned accordingly. The Committee advised NHMRC to finalise all draft guidance (i.e. draft chemical fact sheets and ongoing edits and corrections) for targeted consultation with the enHealth Water Quality Expert Reference Panel (WQERP)**	December 2025
EnHealth WQERP** was consulted on all draft guidance documents (see Appendix C) and subsequent revisions were completed with advice from the Committee.	December 2025 – February 2026
NHMRC Council advice to NHMRC CEO to release draft guidance for public consultation	1 April 2026
NHMRC CEO approval to release draft guidance for public consultation	*April 2026
Public consultation open (minimum 30 days)	*May – June 2026
NHMRC and Committee review of submissions and revision to guidance as required	*July – August 2026
Consult enHealth WQERP** on revised guidance	* August – September 2026
Finalisation of guidance with advice from the Committee	*September – October 2026
Advice from NHMRC Council to publish final guidance in Guidelines	*November 2026
NHMRC CEO final approval to publish guidance in Guidelines	*November – December 2026
Publication of guidance in the *Australian Drinking Water Guidelines*	*December 2026 – January 2027

*Anticipated dates **WQERP: Water Quality Expert Reference Panel

Water Quality Advisory Committee advice

The Committee provides expert advice to NHMRC on public health issues related to drinking water quality. The primary role of the Committee is the rolling review of the Guidelines.

Following the Framework, the Committee provided advice at several meetings or out of session during different stages of the review and guideline development processes, including advice on:

- the draft research protocols for each chemical review
- the draft evidence evaluation reports (initially through the Chemical Subgroup and then the full Committee)
- the candidate guideline options presented in the evidence review reports and evidence to decision tables
- the draft guidance documents (for the chemical fact sheets - initially through the Chemical Subgroup and then full Committee)
- the proposed amendments and corrections to the Guidelines (initially through the Microbial Subgroup and then the full Committee)
- responses to address enHealth Water Quality Expert Reference Panel feedback and finalise the guidance for public consultation.

Targeted consultation

The enHealth Water Quality Expert Reference Panel provided expert feedback on the draft guidance. Panel membership included jurisdictional representatives working in the field of drinking water quality and public health who can provide feedback on the feasibility and accuracy of NHMRC advice.

The enHealth Water Quality Expert Reference Panel was formally consulted on the draft guidance from December 2025 – February 2026 prior to public consultation. A number of amendments to the draft guidance were made with advice from the Committee as a result of feedback provided. Further details on the issues raised by the enHealth Water Quality Expert Reference Panel on the draft guidance and how these issues were addressed is provided in **Appendix C**.

Contributors

The Water Quality Advisory Committee advised on the latest guideline updates for public consultation. Three terms of the Committee were involved in these updates (2019 -2021; 2022 – 2025; 2026 – current).

Water Quality Advisory Committee

Committee membership during these updates of the Guidelines is outlined below.

Water Quality Advisory Committee (2019 to 2021)

- Associate Professor Frederic Leusch (Chair), School of Environment, Griffith University
- Dr David Cunliffe, South Australian Department of Health and Wellbeing
- Ms Miranda Cumpston, Australian Clinical Trials Alliance, Monash University and University of Newcastle
- Mr Cameron Dalgleish, Tasmanian Department of Health
- Dr Daniel Deere, Independent Consultant Water Futures, The University of New South Wales
- Professor Cynthia Joll, Curtin Water Quality Research Centre, Curtin University
- Professor Stuart Khan, Water Research Centre, The University of New South Wales
- Associate Professor Susan Petterson, School of Medicine, Griffith University

- Professor Craig Simmons, School of the Environment, Flinders University
- Ms Carolyn Stanford (Consumer Representative), Stanford Marketing Pty Ltd
- Dr Katrina Wall, New South Wales Health Department
- Dr Nick Fletcher (Observer), Food Standards Australia New Zealand
- Mr Adam Lovell (Observer), Water Services Association of Australia
- Mr Marcus Walters (Observer), Department of Agriculture and Water Resources

Water Quality Advisory Committee (2022 to 2025)

- Professor Nicholas Ashbolt (Chair), Cooperative Research Centre for Solving Antimicrobial Resistance in Agribusiness, Food and Environments (SAAFE CRC), Queensland University of Technology.
- Dr David Cunliffe, South Australian Department for Health and Wellbeing
- Mr Cameron Dalgleish, Tasmanian Department of Health
- Professor Cynthia Joll, Curtin Water Quality Research Centre, Curtin University
- Professor Frederic Leusch, School of Environment and Science, Griffith University (2023 - 2025)
- Mr Peter Rogers, Water and Public Health Expert
- Ms Nicola Slavin, Northern Territory Department of Health
- Dr Bala Vigneswaran, NSW Department of Climate Change Energy the Environment and Water
- Associate Professor Harriet Whiley, College of Science and Engineering, Flinders University
- Dr Sonia Colville (Observer), Department of Climate Change, Energy, Environment and Water (2022 – 2023)
- Ms Yulia Cuthbertson (Observer), Department of Climate Change, Energy, Environment and Water (2024 - 2025)
- Dr Kerry Nugent (Observer), Australian Industrial Chemicals Introduction Scheme (2022)
- Dr Nobheetha Jayasekara (Observer), Australian Industrial Chemicals Introduction Scheme (2023 - 2025)
- Mr Adam Lovell (Observer), Water Services Association of Australia (2022 – 2023)
- Mr Laurence Wilson (Observer), National Indigenous Australians Agency.

Water Quality Advisory Committee (Current membership advising on guideline updates as at 6 March 2026)

- Professor Cynthia Joll (Chair), Curtin Water Quality Research Centre, Curtin University
- Professor Nicholas Ashbolt, Cooperative Research Centre for Solving Antimicrobial Resistance in Agribusiness, Food and Environments (SAAFE CRC), Queensland University of Technology.
- Dr David Cunliffe, South Australian Department for Health and Wellbeing
- Mr Cameron Dalgleish, Tasmanian Department of Health
- Professor Frederic Leusch, School of Environment and Science, Griffith University.

Chemical Subgroup

Drafting of the updated chemical fact sheets was undertaken with assistance from Committee members who were part of the Chemical Subgroup from 2022-2025. The following members of the Water Quality Advisory Committee formed the Chemical Subgroup:

- Professor Cynthia Joll (Subgroup Chair)
- Dr David Cunliffe
- Mr Cameron Dalgleish
- Professor Frederic Leusch

Microbial Subgroup

Drafting of the amendments and corrections, and subsequent revisions was undertaken with assistance from Committee members who were part of the Microbial Subgroup from 2022 - 2025. The following members of the Water Quality Advisory Committee formed the Microbial Subgroup:

- Mr Cameron Dalgleish (Subgroup Chair)
- Professor Nicholas Ashbolt
- Dr David Cunliffe
- Mr Peter Rogers
- Dr Bala Vigneswaran
- Associate Professor Harriet Whiley.

NHMRC Project Team

Project work by NHMRC was undertaken by the Water Team in the Environmental Health Section of the Research Quality and Advice Branch.

Declarations of Interest

Appointees to committees of NHMRC are required to disclose their interests consistent with Section 42A of the Act, and instructions issued under sections 16A and 16B of the Public Governance, Performance and Accountability Rule 2014 (made under subsection 29(2) of the *Public Governance, Performance and Accountability Act 2013*). Prospective members were specifically asked to identify, to the best of their ability, interests including:

- financial interests: an interest must be declared when benefits or losses either in money or in-kind have occurred or may occur at a level that might reasonably be perceived to affect a person's judgement in relation to fair decisions about evidence and their participation in group decision-making
- other relationships: an interest must be declared when a strong position or prejudice or familial connection or other relationship held by a person could reasonably, or be perceived to, affect a person's judgement in relation to fair decisions about evidence and their participation in group decision-making including making an effort to arrive at a consensus
- affiliations to or associations with any organisations or activities that could reasonably be perceived to be an influence due to a competing interest, either for or against the issues being considered by the committee

- any other influences that might reasonably be considered likely to affect the expert judgement of the individual, or lead to the perception by others that the judgement of the individual is compromised.

Under the *Public Governance, Performance and Accountability Act 2013*, members have a responsibility to declare any interests to the whole committee, and members have a joint responsibility to decide on the management of any perceived or real conflict. No unmanageable conflicts were identified by the Committee or NHMRC.

Throughout the project, members were reminded of their obligation to consider any interest that may have arisen since the last meeting or with any particular agenda items. All disclosures and determinations about interests were recorded in the minutes of the Committee meetings. Members' relevant expertise and a summary of their disclosed interests were accessible on the NHMRC website throughout the duration of the project.

The relevant expertise of the Committee and a summary of their disclosed interests during the term of their membership is at **Appendix D**.

Declarations of interest were routinely raised at meetings of the Committee and the Subgroup during drafting of the updated Guidelines. Members of the Committee did not raise any concerns regarding these interests.

Project funding

This work was funded by NHMRC with contributions for evidence reviews from the Commonwealth and the jurisdictions through the Australian Health Protection Principal Committee.

Acknowledgments

NHMRC would like to acknowledge the efforts and contributions of everyone from current and previous terms of the Committee who contributed to the latest guideline updates for public consultation. This includes a special acknowledgement to members of the Chemical Subgroup for assisting with drafting the updated chemical fact sheets, and members of the Microbial Subgroup for supporting the ongoing edits and corrections.

References

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Appendix A – Evidence-to-decision tables

DRAFT Evidence-to-decision table – Ammonia (CAS 7664-41-7)

The Evidence to Decision (EtD) tables below are intended to capture key factors and considerations when comparing and deciding on guideline options. This is in alignment with NHMRC Standards for Guidelines. Note these tables can be updated or amended to capture additional criteria and factors once stakeholder feedback from targeted/public consultation has been received and considered by NHMRC and the Committee.

Note that guideline options presented below are rounded as per the rounding conventions described in Chapter 6 of the *Australian Drinking Water Guidelines*.

Table 2. Comparison of guideline options - ammonia

Criteria	OPTION 1: Maintain current advice No health-based guideline value Aesthetic guideline value for ammonia in drinking water of 0.5 mg/L	OPTION 2: Adopt WHO (2003) No health-based guideline value Decrease aesthetic guideline value for ammonia in drinking water to 0.2 mg/L
Draft recommendation	Based on aesthetic considerations (corrosion of copper pipes and fittings), the concentration of ammonia (measured as total ammonia) in drinking water should not exceed 0.5 mg/L. No health-based guideline value is set for ammonia.	Based on aesthetic considerations (potential for interference with the efficiency of disinfection), the concentration of ammonia (measured as total ammonia) in drinking water should not exceed 0.2 mg/L. No health-based guideline value is set for ammonia.
Critical study	N/A – no health-based guideline value established	N/A – no health-based guideline value proposed

Discussion of evidence-to-decision factors for guideline options – ammonia

Health evidence profile

- Option 1: The principal route of human exposure to ammonium is dietary whereas for ammonia it is from air. Ammonia is added to drinking water used in conjunction with chlorine to form chloramines to disinfect water supplies. Some residual will be present in the water, particularly if the chlorinator is not operating properly. The current aesthetic guideline value of 0.5 mg/L was endorsed in 1996 and is based on corrosion of copper pipes and fittings (NHMRC 2011). The current fact sheet states that ammonia concentrations above 0.5 mg/L may attack copper pipes and fittings or result in nuisance growths of microorganisms that could result in health impacts. Concentrations of ammonia that may directly cause health effects (over 1,000 mg/L) and are unlikely to occur in drinking water supplies; accordingly, no health-based guideline value is set.
- Option 2: A review of current research by EFSA (2012) estimated intakes of ammonia from drinking water from 0.5 - 5 mg/L were approximately three orders of magnitude lower than the no-effect levels reported in reviews of experimental animals and therefore current levels of ammonia do not indicate a health concern. In contrast, approximately 4,000 mg of ammonia per day is produced endogenously in the human intestine. Some consumers such as farm workers may be more exposed to ammonia than the general population, likely from inhalation exposure (not relevant to drinking water). There is also agreement between jurisdictions that persons who suffer from severe liver or kidney disease may be more susceptible to ammonia exposure from various sources, since these organs biotransform and excrete NH_4^+. Individuals with hereditary urea cycle disorders are also more susceptible, since levels produced endogenously are sufficient to produce toxicity in these individuals. SLR (2022a,b) agreed there are no health effects of concern at levels typically observed in drinking water supplies and therefore a health-based guideline value was still not considered warranted. No international agencies reviewed have set a health-based guidance/guideline for ammonia. WHO (2003) identified that a concentration of 0.2 mg/L in water as a level above which ammonia may begin to interfere with the efficiency of disinfection which could lead to health effects. WHO (2003) also noted ammonia can result in nitrite formation in distribution systems, cause the failure of filters for the removal of manganese and cause taste and odour problems.

Exposure profile

- According to ATSDR (2004) and WHO (2003) intakes from food and drinking water are 18 mg/person/day, <1 mg from inhalation and, <1 mg/day from cigarette smoking (20 cigarettes per day). In contrast, approximately 4,000 mg of ammonia per day is produced endogenously in the human intestine.
- A review found no information on typical levels of Australian exposure for ammonia (SLR 2022a,b). Mean concentrations of ammonia in drinking water occur below the current aesthetic guideline value:
    - Range: <0.005-0.373 mg/L (Tas Water)

    - Rainwater tanks around Australia: Mean 0.074 mg/L, Range: 0.002 mg/L - 0.270 mg/L (Chapman et al. 2008)
- Some states report that the current aesthetic guideline value (0.5 mg/L) was met in their latest sampling. There have been reported short-term aesthetic exceedances of ammonia where water has been contaminated with animal waste.
- Chloramination is a common water treatment process used in Australia to treat water for drinking. Monochloramine, however, decays over time releasing free ammonia and chlorine.

Health benefits vs. harms

- Both guideline options propose aesthetic guideline values that are well below the typical smell and taste thresholds for humans so there should be no change to drinking water consumption as a result of implementing either guideline option. While WHO (2003) identified a concentration of 0.2 mg/L in water as a level above which ammonia may begin to interfere with the efficiency of disinfection which could lead to health effects (option 2), it is not considered to have a significant impact in well-controlled Australian systems.

Values and preferences (consumers, communities)

- It is reasonable to assume that consumers and communities would expect that supplied drinking water is safe to drink at the tap and looks, smells and tastes good. Taste (35 mg/L) and odour (1.5 mg/L) thresholds for ammonia are much higher than the proposed aesthetic guideline values.

Acceptability (other key stakeholders)

- Option 1: Maintaining current guideline recommendations for ammonia will result in no change to practice for end users.
- Option 2: Lowering the aesthetic guideline value may have varying levels of acceptability for end users depending on the resulting resource impacts, including:
    - increased regulatory burden for health regulators and/or drinking water authorities as more exceedances in drinking water supplies might be detected as a result of lowering the aesthetic guideline value
    - monitoring and water treatment requirements for water providers may increase or change, especially where exceedance of the aesthetic guideline value has occurred.

Feasibility

- Option 1: This guideline option is feasible as no changes to current practice are required. The current Australian aesthetic guideline value of 0.5 mg/L is achievable with modern treatment technologies and readily measurable with current commercial analytical techniques.

- Option 2: This guideline option is feasible as commercial analytical methods can measure at or below the proposed aesthetic guideline value of 0.2 mg/L (with standard limits of determination of 0.001 mg/L). Further information may be required to determine if current technologies can treat water down to below the proposed aesthetic guideline value.

Health equity impacts

- Based on the available evidence no health-based guideline values for ammonia are being proposed and therefore no health equity impacts are anticipated for either guideline option. The proposed aesthetic guideline options are well below typical smell and taste thresholds that would impact perceptions of acceptable drinking water quality by consumers.

Resource impacts

- Option 1: No resource impacts anticipated. Maintaining current guideline recommendations for ammonia will result in no change to practice for end users.
- Option 2: Lowering the aesthetic guideline value may have resource impacts for some water providers if exceedances are regularly detected. The impact of additional costs and effort is likely to be higher for small water utilities, particularly those in regional and remote Australia. Resulting costs for additional treatment of drinking water supplies, investment in appropriate treatment technologies, operations and maintenance and ongoing sampling costs associated with monitoring and/or removal may be borne by local water providers, which may have flow on costs to consumers and communities.

Table 3. Decisions regarding the guideline options by the Water Quality Advisory Committee - ammonia

Decision	Decisions regarding the following guideline options by the Water Quality Advisory Committee are outlined below:
Option 1	This guideline option was selected as it was agreed that there are no health effects of concern for ammonia at levels typically observed in Australian drinking water supplies. Maintaining the current value of 0.5 mg/L set on aesthetic considerations (corrosion of copper pipes and fittings) was considered appropriate.
Option 2	This guideline option to adopt a value of 0.2 mg/L set on aesthetic considerations to align with WHO (2003) was not selected as it was agreed that ammonia interfering with the efficiency of disinfection would not have a significant impact in well-controlled Australian systems.

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DRAFT Evidence-to-decision table – Nickel (CAS 7440-02-0)

The Evidence to Decision (EtD) tables below are intended to capture key factors and considerations when comparing and deciding on guideline options. This is in alignment with NHMRC Standards for Guidelines. Note these tables can be updated or amended to capture additional criteria and factors once stakeholder feedback from targeted/public consultation has been received and considered by NHMRC and the Committee.

Note that guideline options presented below are rounded as per the rounding conventions described in Chapter 6 of the *Australian Drinking Water Guidelines*.

Table 4. Comparison of guideline options - nickel

Criteria	OPTION 1: Maintain current advice Maintain the current health-based guideline value for nickel of 0.02 mg/L	OPTION 2: Adapt EFSA (2020) & WHO (2021) Increase the current health-based guideline value for nickel to 0.05 mg/L	OPTION 3: OEHHA (2001) Increase the current health-based guideline value for nickel to 0.04 mg/L
Draft recommendation	*Based on health considerations, the concentration of nickel in drinking water should not exceed 0.02 mg/L.*	*Based on health considerations, the concentration of nickel in drinking water should not exceed 0.05 mg/L.*	*Based on health considerations, the concentration of nickel in drinking water should not exceed 0.04 mg/L.*
Critical study	Ambrose (1976)	Chronic: SLI (2000a,b) & RTI (1988a,b) - cited by EFSA (2020a) & WHO (2021). Acute: Jensen et al. (2003) - cited by EFSA (2020a) & WHO (2021).	Smith et al. (1993) & SLI (2000a,b)

Discussion of evidence-to-decision factors for guideline options – nickel

Health evidence profile

- Option 1: The current Australian health-based guideline value of 0.02 mg/L was derived from a NOAEL of 5 mg/kg bw/d for altered organ-to-body weight ratios in rats. The NOAEL was identified from Ambrose (1976), in which rats were exposed to nickel sulfate hexahydrate for 2 years. The current health-based guideline value was calculated using the NOAEL and an uncertainty factor of 1000 (10x interspecies variation, 10x intraspecies variation, 10x to compensate for the lack of adequate studies on chronic effects and for increased intestinal absorption when taken on an empty stomach). The current health-based

guideline value is considered to be conservative and protective of human health. However, it does not consider more recent, higher quality studies exploring both chronic and acute critical health effects.

- Option 2: The proposed drinking water guideline value of 0.05 mg/L (rounded) is derived from a chronic endpoint and supported by an exposure assessment using an acute endpoint. Thus, it is protective of adverse effects from both chronic and acute nickel exposure. For chronic exposure, a $BMDL_{10}$ of 1.3 mg/kg bw/d for reproductive and developmental toxicity (i.e. post-implantation loss) in female rats was identified. This $BMDL_{10}$ is derived from SLI (2000b), a 2-generation study in which rats were exposed to nickel sulfate hexahydrate via oral gavage over a 3-week (to birth) and 24-week (post birth) timeframe. Both EFSA (2020a) and WHO (2021) derived a chronic TDI of 0.013 mg/kg bw/d using the $BMDL_{10}$ and a UF of 100. WHO also derived a drinking water guideline of 0.08 mg/L (although the previous drinking water guideline of 0.07 mg/L was retained). To characterise risks from acute exposure to nickel, and whether the health-based guideline value for chronic exposure was also protective of acute exposures, EFSA (2020a) undertook a margin of exposure (MOE) assessment. For use in the MOE, a LOAEL of 0.0043 mg/kg (0.3 mg Ni per person, assuming a body weight of 70kg) for systemic contact dermatitis/eczematous flare up reactions in nickel sensitive individuals from acute oral exposure was identified. This LOAEL is derived from Jensen et al. (2003), in which 40 nickel sensitive individuals, and 20 non-nickel sensitive individuals were exposed to nickel sulfate hexahydrate in a fasted state, in doses similar to and greater than the amount of nickel typically ingested in the normal Danish diet. Under study conditions, absorption is assumed to be higher than from food. A previous MOE assessment (EFSA 2015b) used a $BMDL_{10}$, but the switch to a LOAEL was preferred because of the unavailability of new studies and the uncertainty in the resulting BMDL modelling, which showed poor constraint that spanned two orders of magnitude. This LOAEL was divided by estimated mean and 95th percentile acute dietary exposures for all age ranges. All MOEs calculated were <30. EFSA (2020a) determined that an MOE ≥30 indicated a low health concern, meaning that MOE values raise a health concern for nickel-sensitised individuals. An additional exposure scenario was undertaken to estimate the dietary exposure when drinking a small bottle of water (500 mL) containing a high concentration of nickel under fasted conditions. Calculated MOE values were 120 and 55, respectively (using exposures of 0.00004 mg/kg bw and 0.00008 mg/kg bw). These MOE values did not raise a health concern. WHO (2021) references EFSA's MOE assessment and note that in a scenario where a nickel-sensitised person drinks 200 mL of tap water containing nickel at the drinking water guideline of 80 µg/L while in a fasted state, the estimated acute exposure is 0.00027 mg Ni/kg bw. This corresponds to a MOE of approx. 16. As everyday exposure to drinking-water is intermittent and lower in concentration to doses used in Jensen et al. (2003), the MOE was considered a low concern to health. SLR (2022b) repeated the MOE assessment using the same LOAEL but a different estimated Ni intake of 0.00013 mg/kg (proposed guideline of 0.0455 mg/L x 0.2L ÷ 70 kg body weight), assuming an individual in a fasted state consumes a glass of water (200 ml). The MOE was 33, with ≥30 indicating a low health concern. The resulting adaptation of the chronic health-based guidance value (supported by an assessment to characterise acute risks) results in an Australian health-based guideline value of 0.05 mg/L (rounded). SLR (2022) reported greater confidence in the benchmark dose analysis approach to determine

a chronic exposure point of departure selected by EFSA (2020a) and adopted in WHO (2021). Both jurisdictions agree on a chronic critical health effect and the use of a MOE assessment to account for health effects from acute exposure. Furthermore, both reviews are recent and use up-to-date methods to synthesise the underpinning evidence.

- Option 3: The proposed drinking water guideline value of 0.04 mg/L (rounded) is derived from a NOAEL of 1.12 mg/kg bw/day for developmental toxicity (increased perinatal mortality) observed in female rats. This NOAEL is derived from SLI (2000b) (2-generation study), in which rats were exposed to nickel sulfate hexahydrate via oral gavage over a 3-week (to birth) and 24-week (post birth) timeframe. OEHHA (2001) derived a public health goal of 0.012 mg/L using the NOAEL a UF of 1000, a relative source contribution of 30%, and adult body weight and daily water consumption aligning with Australian default assumptions. The UF consisted of 10x each to account for the uncertainty in interspecies extrapolation and intraspecies variability, and 10x to account for the potential carcinogenicity of soluble nickel by the oral route. SLR (2022b) determined the 10x UF for potential carcinogenicity is not in line with Australian risk assessment policy. It was excluded in the calculation of a potential Australian health-based guideline value for adoption/adaption. The resulting adaptation of the health-based guidance value results in an Australian health-based guideline value of 0.04 mg/L (rounded). SLR (2022b) reported lower confidence in the approach taken by OEHHA (2001), as it is not based on the most recent benchmark dose analysis undertaken by international jurisdictions.

Exposure profile

- Evidence suggests the major exposure source of nickel is the diet. Other exposure sources of note are inhalation, contact with coins containing nickel and the smoking of tobacco. Exposure is estimated to be low from drinking water in uncontaminated sources.
- Mean dietary exposures of Ni in Australian consumers (FSANZ 2008): Adult men: 150 µg/day (0.15 mg/day); Adult women: 115 µg/day (0.115 mg/day)
- Nickel is poorly absorbed from the GI tract, with absorbed nickel less than 1% of the dose ingested in food. In contrast, an approximately 30-fold higher absorption occurred when the same dose of nickel was ingested in drinking water (FSANZ 2008).
- The available data on nickel in Australian drinking water reports a mean concentration of generally less than 0.001-0.01 mg/L.
- Concentrations in Australian drinking water :
- ACT (ICON Water): Minimum: <0.001 mg/L; Maximum: 0.003 mg/L; Mean: <0.001 mg/L; 95th percentile: <0.001 mg/L.
- VIC (Melbourne Water): Mean: <0.001 mg/L.
- NT (PWNT): Range of means: 0.001-0.015 mg/L.
- QLD (Seqwater): Mean: <0.001 mg/L.

- Tas (Tas Water): Range of means: <0.0005 – 0.003 mg/L; Minimum range: <0.0005 – 0.0007 mg/L; Maximum range: 0.0005 – 0.007 mg/L.
- Rainwater tanks (Chapman et al. 2008): Mean: 0.002 mg/L; Minimum: 0.0005 mg/L; Maximum: 0.005 mg/L.
- Individuals living within the vicinity of operating industry sites (e.g. nickel mines and/or smelters, electroplating facilities) may have higher exposure to nickel via contaminated dust and water sources.
- Although reported less frequently, nickel may also be present in drinking water due to its use in the manufacture of a variety of plumbing pipework (e.g. nickel-plated fittings) and other products. First-run drinking water has been reported to be as high as 1 mg/L in European and US supplies (EFSA 2005; OEHHA 2001). Nickel may also be present as a contaminant in drinking water treatment chemicals (NHMRC 2011).

Health benefits vs. harms

- Some of the guideline values under consideration are more conservative than others, and as a result would be considered more protective of public health. These guideline options would be more protective of the general population, including groups that may be more sensitive (e.g. nickel sensitised individuals and the developing foetus). However, the choice of guideline option should balance the need for conservatism against the best available evidence and consider appropriate levels of uncertainty in their derivation.

Values and preferences (consumers, communities)

- It is reasonable to assume that consumers and communities would expect that:
    - supplied drinking water is safe to drink at the tap
    - water sources close to mine sites are monitored frequently
    - that new/emerging risks to public health from drinking water are considered by NHMRC and appropriate action is taken depending on the risks to public health and that all guideline options under consideration will be protective of public health.
- Given the health evidence has been reviewed, clear justification for setting a revised guideline value should provide some certainty to consumers, communities and end users that the guideline value is based on the best available evidence.

Acceptability (other key stakeholders)

- Option 1: Maintaining current guideline recommendations for nickel will result in no change to practice for end users.
- Options 2 -3: An increase to the health-based guideline value may be interpreted by end users as not being protective of public health. A clear justification must be provided if an increased health-based guideline value is preferred. The probability of

nickel sensitive individuals experiencing adverse health effects when acute exposure occurs may be higher when a guideline is increased, this must be considered.

Feasibility

- Option 1: This guideline option is feasible as no changes to current practice are required.
- Options 2 -3: An increased health-based guideline value will be feasible and achievable with existing treatment technologies and readily measurable with current commercial analytical techniques.

Health equity impacts

- Some of the guideline values under consideration are more conservative than others, and as a result would be considered more protective of public health. These guideline options would be more protective of the general population, including groups that may be more sensitive (e.g. nickel sensitised individuals, the developing foetus). Implementing more conservative guideline options could potentially overestimate the health risks, which may disadvantage communities that already experience challenges meeting the current guideline values.

Resource impacts

Option 1: No resource impacts anticipated. Maintaining current guideline recommendations for nickel will result in no change to practice for end users.

Options 2 – 3: No resource impacts anticipated. Increasing current guideline recommendations for nickel will result in no change to practice for end users.

Table 5. Decisions regarding the guideline options by the Water Quality Advisory Committee - ammonia

Decision	Decisions regarding the following guideline options by the Water Quality Advisory Committee are outlined below:
Option 1	This guideline option was not selected as the underpinning study was considered outdated, with more recent, higher quality health evidence available.
Option 2	This guideline option was selected as it was considered to be based on the most recent benchmark dose analysis undertaken by international jurisdictions.
Option 3	This guideline option was not selected as adaption of a more recent benchmark dose analysis undertaken by international jurisdictions was considered more appropriate (see Option 2).

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DRAFT Evidence-to-decision table – Chlorate (CAS 14866-68-3)

The Evidence to Decision (EtD) tables below are intended to capture key factors and considerations when comparing and deciding on guideline options. This is in alignment with NHMRC Standards for Guidelines. Note these tables can be updated or amended to capture additional criteria and factors once stakeholder feedback from targeted/public consultation has been received and considered by NHMRC and the Committee. Note that guideline options presented below are rounded as per the rounding conventions described in Chapter 6 of the Australian Drinking Water Guidelines.

Table 6. Comparison of guideline options - chlorate

Criteria	OPTION 1: Maintain status quo No health-based guideline value for chlorate in drinking water	OPTION 2: Adapt WHO (2016) Establish new health-based guideline value for chlorate in drinking water of 0.3 mg/L	OPTION 3: Adapt US EPA (2006/2016) Establish new health-based guideline value for chlorate in drinking water of 0.8 mg/L	OPTION 4: Adapt EFSA (2014, 2015) Establish new health-based guideline value for chlorate in drinking water of 0.1 mg/L	OPTION 5: Adapt Health Canada (2008) Establish a new health-based guideline value for chlorate in drinking water of 0.8 mg/L
Draft recommendation	Data are insufficient to set a guideline value in drinking water.	Based on health considerations, the concentration of chlorate in drinking water should not exceed 0.3 mg/L.	Based on health considerations, the concentration of chlorate in drinking water should not exceed 0.8 mg/L.	Based on health considerations, the concentration of chlorate in drinking water should not exceed 0.1 mg/L.	Based on health considerations, the concentration of chlorate in drinking water should not exceed 0.8 mg/L.
Critical study	N/A – no health-based guideline value established.	NTP (2005)	NTP (2005)	Chronic: Greer et al. (2002) Acute: Lubbers et al. (1981)	McCauley et al. (1995)

Discussion of evidence-to-decision factors for guideline options – chlorate

Health evidence profile

- Option 1: The current fact sheet for *Chlorine dioxide, Chlorite and Chlorate* was endorsed in 2011. A review of the health evidence and occurrence and sources of chlorate in Australian water undertaken at this time concluded that there was insufficient data to set a guideline value for chlorate in Australian drinking water supplies. A recent review of existing health-based guidance/guideline values for chlorate identified a number of potential guideline values that were found suitable to adopt/adapt for the Australian context (CDM Smith 2025). Given the importance of maintaining adequate disinfection of water supplies and limited options for reducing chlorate levels in supplies treated with hypochlorites, establishment of a health-based guideline value must be practically achievable and consider implications for Australian suppliers.
- Option 2: WHO (2016) established an acceptable daily intake (ADI) of 0.011 mg/kg bw/day and a provisional drinking water guideline value of 0.7 mg/L. These are informed by a $BMDL_{10}$ of 1.1 mg/kg bw/day, derived by JECFA (2008). The $BMDL_{10}$ is based on thyroid effects (increased thyroid gland follicular cell hypertrophy), and was determined using data from a chronic, carcinogenicity study in rats (NTP 2005). In this study, male rats were exposed to varying doses of sodium chlorate in the drinking water for 2-years. JECFA (2008) considered humans to be less sensitive to the effects of agents that disrupt thyroid hormone homeostasis, such as chlorate, compared to rats. Due to this, an uncertainty factor for interspecies variation was not required. WHO (2016) agreed and adopted this approach. WHO (2016) chose to retain the provisional drinking water guideline of 0.7 mg/L, established in 2005. Considering the challenges in storage conditions and in the prevention of chlorate formation in treated water supplies, especially for small, resource-limited water suppliers, the calculated health-based guideline value of 0.3 mg/L was deemed impractical. CDM Smith (2025) reported having the highest confidence in the underpinning study and approach used by WHO (2016). The resulting adaptation of WHO (2016) results in an Australian health-based guideline value of 0.3 mg/L (rounded).
- Option 3: US EPA (2006/2016) established a chronic reference dose (RfD) of 0.03 mg/L, and a calculated long-term non-cancer health reference level (HRL) of 0.21 mg/L. These are informed by a BMDL of 0.9 mg/kg bw/day. This BMDL is based on thyroid effects (increased follicular cell hypertrophy) and was derived from the same chronic study in rats used by WHO (2016) (NTP 2005). The BMDL of 0.9 mg/kg bw/day represents a concentration of the chlorate ion and corresponds to 28 mg/L as sodium chlorate, and 22 mg/L as chlorate. In calculation of the HRL, US EPA (2006) adopt a RSC of 20% - the most conservative RSC used in the derivation of a maximum contaminant level goal (MCLG) for drinking water.This was selected in the absence of a complete exposure assessment for chlorate. Unlike WHO (2016), US EPA did not consider a 10x uncertainty factor for deficiencies in the toxicological database necessary, stating the database for chlorate includes sub-chronic, chronic,

developmental and reproductive studies. The resulting adaptation of US EPA (2006/2016) results in an Australian health-based guideline value of 0.8 mg/L (rounded).

- Option 4: EFSA (2014, 2015) established a tolerable daily intake (TDI) of 0.003 mg/kg bw/day, which is supported by an acute reference dose (ARfD) of 0.036 mg/kg bw/day. In 2015, EFSA established a TDI for chlorate of 0.003 mg/kg bw/day. This was calculated using a TDI of 0.0003 mg/kg bw/day for perchlorate, established in 2014, and a factor of 10 to account for the lower potency of chlorate. The perchlorate TDI was informed by a $BMDL_{05}$ of 0.0012 mg/kg bw/day, based on thyroid effects (inhibition of thyroid iodine uptake) observed in Greer et al. (2002). In this study, human volunteers were exposed to perchlorate in varying daily doses in the drinking water for 14-days. An uncertainty factor of 4 to allow for interspecies variability was used to calculate the final TDI. CDM Smith (2025) reported having high confidence in Greer et al. (2002). In 2015, to support the chronic guideline value, EFSA established an ARfD of 0.036 mg/kg bw/day. This was informed by adverse effects (haematological and renal toxicity) observed in a number of human poisoning cases, and by outcomes of a human volunteer study (Lubbers et al. 1981). In this study, human volunteers were exposed to 5 mg/L sodium chlorate in the drinking water for 12-weeks. No adverse effects were observed, with EFSA determining the equivalent dose of chlorate tolerated by humans in the study (0.036 mg/kg bw/day) to represent the ARfD. CDM Smith (2025) reported having medium to high confidence in Lubbers et al. (1981). This option takes an alternate approach in deriving health-based guideline values, relying on human volunteer data as opposed to experimental animal data. The resulting adaptation of EFSA (2014,2015) results in an Australian health-based guideline value of 0.1 mg/L (rounded). In 2025, EFSA revised the TDI for perchlorate to 0.0014 mg/kg bw/day. This is informed by an updated $BMDL_{05}$ of 0.007 mg/kg bw/day, again using Greer et al. (2002) and an uncertainty factor of 5 to allow for interspecies variability. This value supersedes the 2014 TDI for perchlorate of 0.0003 mg/kg bw/day. An update to the 2015 guidance – *Risks for public health related to the presence of chlorate in food* – is anticipated. If adopting the same approach as 2015 guidance, a theoretical revised TDI for chlorate would be 0.014 mg/kg bw/day. The resulting adaptation of this theoretical TDI for chlorate from EFSA (2025) results in an Australian health-based guideline value of 0.4 mg/L (rounded).
- Option 5: Health Canada (2008) established a TDI of 0.03 mg/kg bw/day and a maximum acceptable concentration (MAC) of 1 mg/L. These are informed by a NOAEL of 30 mg/kg bw/day. The NOAEL is based on thyroid effects (thyroid gland colloid depletion), and was determined using data from a sub-chronic study in rats (McCauley et al. 1995). In this study, male rats were exposed to varying doses of sodium chlorate in the drinking water for 90-days. 30 mg/kg bw/day represents the concentration in which no adverse effects were observed. Health Canada considered the TDI of 0.03 mg/kg bw/day to be consistent with results from human volunteer studies, namely Lubbers et al. (1981). In this study, a chlorate dose of 0.036 mg/kg bw/day for 12-weeks did not result in any adverse effects. This option is informed by data from an older, sub-chronic study in rats (McCauley et al. 1995) in which a much higher endpoint in comparison to other options is derived. It does not incorporate benchmark dose

analysis of data from a more recent, chronic study in rats (NTP 2005). However, CDM Smith (2025) did report having high confidence in the underpinning study. The resulting adaptation of Health Canada (2008) results in an Australian health-based guideline value of 0.8 mg/L (rounded).

Exposure profile

- There is limited data on exposure to chlorate in the Australian population. The major route of environmental exposure to chlorate is through chlorinated drinking water. Chlorate forms as a by-product in drinking water supplies that use hypochlorite and/or chlorine dioxide for disinfection. Various factors may impact the degree of chlorate formation including the process conditions of water treatment plants, the storage conditions and degradation of hypochlorites, and the applied dose of disinfectants.
- In the US, chlorate is introduced to the food supply when tap water containing chlorate is used for food preparation, when crops are treated with sodium chlorate as an herbicide and when chlorine dioxide and/or hypochlorites are used as disinfectants by the food industry (US EPA 2016). US EPA report 90th percentile concentrations of chlorate in systems that use hypochlorites of 0.24 mg/L, that use chlorine dioxide of 0.26 mg/L, and that use a mixture of both of 0.24 mg/L. Chlorate concentrations above 1 mg/L have been reported in water supplies treated with hypochlorites, although concentrations this high are an anomaly and are a result of hypochlorites stored under adverse conditions (Stanford et al. 2011).
- Recent typical values for chlorate concentrations in drinking water from Australian water suppliers:
    - QLD: SEQ Water (2025): range of means: <0.005 mg/L – 0.155 mg/L; reported LOR: 0.005 mg/L. Unitywater (2016 – 2024): range of means: 0.04 mg/L – 0.25 mg/L; reported LOR: 0.01 mg/L. Gold Coast Water (2023 – 2024): mean: 0.07 mg/L.
    - TAS: TAS Water (2024 – 2025): range of means: 0.03 mg/L – 0.82 mg/L; reported LOR: 0.02 mg/L.
    - VIC: South East Water (2023 – 2024): mean: 0.07 mg/L; reported LOR: 0.01 mg/L.
- Limited treatment methods are available for removing chlorate from water supplies, with those that are effective, being expensive. Preventing chlorate formation is the most viable method of reducing exposure to chlorate (CDM Smith 2025).

Health benefits and harms

- <u>Option 1:</u> Maintaining an absence of a guideline recommendation for chlorate may not be considered protective of public health. Given that a recent review of health evidence has identified several potential guideline values suitable for adoption or adaptation to the Australian context, it is important to consider establishing a health-based guideline value that reflects the best available evidence and is practically achievable.

- Options 2 – 5: Exposure to elevated concentrations of chlorate in drinking water is potentially harmful to human health. Data in both experimental animals and human volunteers show the thyroid to be particularly sensitive to the effects of chronic exposure to chlorate. It is important to note that humans are likely to be less sensitive than rats to these effects, as the effects of agents that disrupt thyroid hormone homeostasis are enhanced in rats. For acute exposure, prominent adverse effects observed in human data include haematological effects i.e. methaemoglobinaemia, and renal effects i.e. renal failure (EFSA 2015). Acute exposure to high concentrations of chlorate in drinking water is unlikely. Lower guideline options are more conservative options compared to higher guideline values. However, the choice of guideline option should balance the need for conservatism against the highest quality evidence and whether the health endpoints under consideration (if using animal studies) are relevant and critical to humans.

Values and preferences (consumers, communities)

- Exposure to disinfection by-products in treated water supplies, and the potential adverse health effects resulting from exposure are an on-going concern to consumers, water suppliers and health agencies. It is reasonable that consumers and communities would expect that:
  - supplied drinking water is safe to drink at the tap
  - that new/emerging risks to public health from drinking water are considered by NHMRC and appropriate action is taken depending on the risks to public health
  - that all guideline options under consideration will be protective of public health
  - water suppliers use best practice to minimise the formation of chlorate in treated water supplies
  - water supplies treated with chlorine dioxide and hypochlorite undergo regular monitoring for chlorate.

Acceptability (other key stakeholders)

- Option 1: Maintaining an absence of a guideline recommendation for chlorate will result in no change to practice for the majority of end users. In April 2022, Queensland Health developed an interim health-based guideline value for chlorate of 0.8 mg/L to assist in the regulation of drinking water safety, and in the management of associated risks. This is used operationally by water suppliers in Queensland, with exceedances reported to the regulator as an event. (Unitywater 2023-24).
- Options 2 – 5: Establishment of a guideline value at a lower concentration:
  - is considered more conservative, and may be perceived as being more health protective
  - may be more difficult to implement and may place strain on water suppliers
  - may result in more exceedances detected, which may increase regulatory burden for water suppliers, health regulators and/or drinking water authorities

    - lack of alignment with other jurisdictions — both internationally and domestically — who establish a higher guideline value e.g. 0.7 mg/L by WHO (2016), 0.8 mg/L by Queensland Health.
- Establishment of a guideline value at a higher concentration:
    - may be considered less conservative and less health protective
    - may be more achievable to implement and place less strain on water suppliers
    - will result in less exceedances being detected, thus reducing regulatory burden for health regulators and/or drinking water authorities
    - alignment with other jurisdictions — both internationally and domestically — who establish a higher guideline value e.g. 0.7 mg/L by WHO, 0.8 mg/L by Queensland Health.
- Establishing a health-based guideline value for chlorate in drinking water will align Australia with international jurisdictions that currently regulate chlorate in drinking water. If the established guideline value is adopted in relevant drinking water legislation by states and territories, an increase in monitoring requirements for water suppliers that use hypochlorites and/or chlorine dioxide for treatment may ensue.

Feasibility

- Option 1: Maintaining an absence of a guideline recommendation for chlorate is feasible as no changes to current practice are required.
- Options 2 – 5: Establishment of a health-based guideline value at concentrations considered in the guideline options above will be readily measurable with current commercial analytical techniques. Limits of reporting (LOR) as advised by Australian commercial laboratories are 0.01 mg/L (US EPA 300 method) and 0.001 mg/L (APHA 4110 B (IC) method). Given the limited availability of affordable treatment techniques and the difficulty in preventing chlorate formation in water supplies, the level at which an established health-based guideline value for chlorate that is considered to be feasible is unclear. Data from US treatment plants show that >90% of treatment plants detected concentrations of chlorate <0.7 mg/L (i.e. the WHO provisional drinking water guideline). Although, challenges in meeting a lower concentration of 0.3 mg/L (the WHO (2016) calculated health-based guideline value) were evident (CDM Smith 2025). Resources from the American Water Works Association (AWWA B300 Hypochlorite Standard updated in 2018) includes instructions on storage, use and handling of hypochlorites to minimise chlorate formation in treated water supplies (AWWA 2018).

Health equity impacts

- Some of the guideline values under consideration are more conservative than others, and as a result would be considered more protective of public health. These guideline options would be more protective of the general population, including groups that may be more sensitive (e.g. infants, children, pregnant women, individuals with pre-existing blood conditions, individuals with glucose-6-phosphate dehydrogenase deficiency). Implementing more conservative guideline options could potentially overestimate the health risks, which may disadvantage water suppliers that may face challenges in meeting a conservative guideline value. Disinfection should never be compromised in order to control disinfection by-products, such as chlorate. The risk pathogenic microorganisms pose to public health is far greater than the possible presence of disinfection by-products.

Resource impacts

- Option 1: No resource impacts anticipated. The absence of a guideline recommendation for chlorate will result in no change to practice for end users.
- Options 2 -5: Establishing a health-based guideline value for chlorate may result in resource impacts. Water suppliers operating within jurisdictions that chose to adopt the guideline value in their respective drinking water regulations will require resources for monitoring and testing. This will place strain on smaller, resource-limited suppliers, or those who face issues in controlling chlorate formation in treated water supplies. Chlorate is predominantly an issue where hypochlorite solutions have long transport and storage times, and where storage is in warm-hot temperatures (e.g. regional and remote communities), placing an additional strain on utilities servicing these communities. Ongoing sampling costs associated with monitoring, and resulting costs for advancements in chemical storage, and on more frequent chemical turnover may be borne by water suppliers, which may have flow on costs to consumers and communities. Extreme weather events may limit or cut delivery access for hypochlorites, particularly in remote regions. As a result, water suppliers may need to hold large stock for extended periods, which can lead to increased loss of solution strength and chlorate formation (Qldwater 2018).

Table 7. Decisions regarding the guideline options by the Water Quality Advisory Committee - chlorate

Decision	Decisions regarding the following guideline options by the Water Quality Advisory Committee are outlined below:
Option 1	This guideline option was not selected as it was considered that sufficient evidence was available to set a health-based guideline value for chlorate.
Option 2	While this guideline option used the same underpinning study as Option 3, this guideline option was not selected as adoption/adaption of the benchmark dose analysis and uncertainty factor used by US EPA (2006/2016) were considered more appropriate for guideline derivation (see Option 3). However, a relative source contribution of 80% for drinking water, consistent with WHO advice, was considered most appropriate for guideline derivation.
Option 3	This guideline option was selected as it was considered to be based on the best available evidence (NTP 2005) using benchmark dose analysis and uses appropriate uncertainty factors. A relative source contribution of 80% from drinking water, consistent with the WHO (see Option 2), was considered most appropriate for guideline derivation.
Option 4	This guideline option was not selected as there was greater certainty in the key study and approach used by US EPA (2006/2016) (see Option 3).
Option 5	This guideline option was not selected as it considered to be based on an older, subchronic study in rats (McCauley et al. 1995) and does not incorporate benchmark dose analysis of data from a more recent, chronic study in rats (NTP 2005) (Option 2).

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Appendix B – Table of ongoing edits and corrections to the Guidelines

[table of edits and corrections to be inserted for final publication]

Appendix C – EnHealth feedback on draft guidance

The enHealth Water Quality Expert Reference Panel was formally consulted from December 2025 to February 2026 to seek their review and advice on the draft public consultation guidance, which included:

- revised draft chemical fact sheets on ammonia, nickel and chlorate
- consequential updates throughout the Guidelines to ensure alignment with the draft chemical fact sheets
- proposed edits and corrections to Chapter 5 of the Guidelines (*Microbial Quality of Drinking Water*), Appendix 3 (*Derivation of microbial treatment targets for enteric pathogens*), ISO and AS/NZS Standards, and other amendments throughout the Guidelines.

EnHealth Members provided feedback as specific comments and/or tracked changes in the documents. The following issues were raised during consultation:

- the need to update references to support text in the ammonia fact sheet within the 'Health considerations' section
- issues with the suitability and scope of some cited analytical method references in the chlorine dioxide, chlorite and chlorate fact sheet.
- alignment with the Australian Guidelines for Water Recycling (Phase 2)
- questions with inclusion of microbial health-based targets in verification and operational monitoring sections
- other text amendments suggested to improve consistency, clarity and flow of the Guidelines.

A summary of feedback and subsequent action/responses are provided in the following table.

Table 8. Summary of feedback from enHealth Water Quality Expert Reference Panel

Draft Guidance	Feedback received	Response
Ammonia chemical fact sheet	The statement "At doses above 32 mg ammonium per kilogram body weight per day (mg/kg bw/day), ammonium chloride influences metabolism" was attributed to an EFSA (2012) document; however, feedback advised that this information could not be located in that source.	Noted and updated. The information was likely sourced from the WHO '*Ammonia in Drinking Water*' 2003 background document, and so the in-text citation and reference list have been updated accordingly.
Ammonia chemical fact sheet/ consequential edits	Inconsistency between the fact sheet and consequential edits regarding the taste and odour threshold for ammonium and ammonia, respectively.	Accepted. Taste (35 mg/L for ammonium) and odour (1.5 mg/L for ammonia) threshold levels updated in the ammonia fact sheet to align with the evidence review and the consequential edits.

Draft Guidance	Feedback received	Response
Chlorine dioxide, chlorite and chlorate fact sheet	The draft fact sheet referenced analytical methods from *APHA, AWWA, WEF (2005), Method 4500 Cl*; however, feedback noted that this method applies to chlorine rather than to chlorine dioxide, chlorite or chlorate, and therefore considered it inappropriate for inclusion.	Noted and updated. The latest '*APHA, AWWA, WEF (2023), Method 4500-Chlorine Dioxide'* recommends that the chlorine dioxide and chlorine method documents be read together. Accordingly, both method documents kept and updated to the latest versions in the fact sheet.
Ongoing edits & corrections Section 5.2 of the Guidelines	Concerns about introducing new terms such as *saprozoic* and *Opportunistic Premise Plumbing Pathogens*, noting that these may add unnecessary complexity unless intended for ongoing, consistent use; the term *opportunistic pathogens* is already well understood within the sector and would be sufficient.	Noted and partially accepted. The term *opportunistic pathogens* retained and *Opportunistic Premise Plumbing Pathogens* introduced, reflecting its increased use in the literature (Whiley et al. (2014), Hayward et al. (2025) CDC). A proposed definition has been included in the glossary to support clarity.
Ongoing edits & corrections Section 5.4.2 of the Guidelines	Align the Guidelines with the Australian Guidelines for Water Recycling (AGWR) Phase 2 which provides health-based targets for storm water, greywater and sewage catchments.	Accepted. A reference to health-based targets in the AGWR has been included to ensure alignment between the Guidelines.
Ongoing edits & corrections Section 9.5.2 and 10.2.1 of the Guidelines	Questioned the inclusion of microbial health-based targets in verification and operational monitoring, noting that verification monitoring assesses treatment effectiveness rather than health-based targets; critical control point (CCP) failure represents acute operational risks, whereas health-based targets relate to long-term risk/treatment requirements and are not intended for an operational assessment.	Accepted. Wording has been revised to focus on immediate and future risk management and corrective actions. References to health-based targets have been removed.
Ongoing edits & corrections Appendix 1, Table A1.10	Update Table A.1.10 (*Example – potential critical control points and operational criteria*) in the: • filtration row for the suggested critical limit, to align to the turbidity fact sheet. • primary disinfection and storage row for the suggested critical limit, to align with the Information Sheets 1.2 (*Overview of disinfection*) and 1.3 (*Disinfection with chlorine*)	Accepted. • The filtered water turbidity updated to "<0.2 NTU, and should not exceed 0.5 NTU at any time. Target value: <0.5 NTU at all times" • The free chlorine residual updated to ">1 mg/L to ≥0.5 mg/L."

Appendix D - Declarations of interest

The declarations of interest of Committee members at the time of their involvement in the development of the guidance are listed in the tables below. Consideration of the declarations of interests of members of the Water Quality Advisory Committee at the time of their various terms of membership (2018 – 2021; 2022 – 2025; 2026 – 2028) were undertaken according to NHMRC committee policy at the time.

Declarations of Interests for Water Quality Advisory Committee members (2019-March 2026)

Professor Nicholas Ashbolt (Chair 2022-2025) - Cooperative Research Centre for Solving Antimicrobial Resistance in Agribusiness, Food and Environments (SAAFE CRC), Queensland University of Technology.

- **Committee terms:** 2022 – 2025, 2026 – current
- **Declaration of interests:**
    - Professor in Environmental Engineering, Faculty of Engineering, School of Civil & Environmental Engineering, Queensland University of Technology (September 2025–)
    - Participates in risk assessment projects with the Cooperative Research Centre for Solving Antimicrobial Resistance in Agribusiness, Food and Environments (CRC SAAFE), in collaboration with Water RA and the South Australian Environmental Protection Authority (SA EPA) (December 2024–)
    - Executive Dean, Faculty of Science and Environment, Southern Cross University (July 2019-August 2023)
    - Peter Teasdale Chair in Environmental Health Risk Assessment (September 2023-September 2025)
    - Research Professor, School of Public Health, University of Alberta, Canada (2013-2019)
    - WHO Technical Advisory Group on Water Quality and Health (since 2015-current), for input into drinking, recreational and reuse guidance documents and microbial pathogen performance of on-site drinking water treatment devices. Unpaid except for travel and accommodation costs covered by the World Health Organization.
    - International Water Association Publishing, Editor in -chief, Journal of Water and Health. Editor in Chief voluntary role as part of my professional contributions as a Fellow of the International Water Association
    - Water Research Foundation (WRF) Academic Advisory Committee (2016-2019) and Project Advisory Committee (PAC, 2019-2022) for WRF 5040, Successful Implementation of Decentralized Reuse and Treatment Systems, PAC (2024-2026) for WRF 5218, Inactivation of amoeba-internalized *Legionella pneumophila* by UV-LED and multi-barrier approaches.
    - Travel, accommodation and workshop paid by SUEZ CIRSEE (Paris) for my role as a mentor for their Health and Environment postgraduate conference, Cannes, France June 26-28, 2023; June 24-26, 2024 and technical advisory team with four other invited senior academics across England, France and Australia
    - National Water Research Institute (NWRI) expert panel member for the City of San Francisco's Risk Based Framework for the Development of Public Health Guidance for Decentralized Non-potable Water Systems (2015-2016); Advisory Panel on Regulations for Onsite Treatment and Reuse of Non-potable Water for California State Water Board to support rulemaking as described in Senate Bill (SB) 966, and NWRI Panel on Regulations for Onsite Treatment and Reuse of non-potable Water (2020-21) for the State Water Board to adopt regulations for risk-based water quality standards for the onsite treatment and reuse of non-potable water for non-potable end uses in multifamily residential, commercial, and mixed-use buildings before December 1, 2022.

- Royalties from patents managed by Macquarie University, Australia. Two patents for the one invention: Method for the detection of viable *Cryptosporidium parvum* oocysts; Australian patent. Method for the detection of viable *Cryptosporidium parvum* oocysts, US patent.
- Senior editor, HealthStream (Water Research Australia)
- Partner works on novel biological wastewater treatment technologies and formed a company based in Edmonton, Alberta in 2021 called Water^3 to commercialise some of these technologies.
- Executive Dean, Faculty of Science and Environment, Southern Cross University (2019-2023)
- Competitive grants received while working at the University of Alberta (2013-2019); Southern Cross University (2020-2024); Queensland University of Technology (2025-2031).

Dr David Cunliffe - Principal Water Quality Adviser, Health Regulation and Protection, SA Health

- **Committee terms:** 2019 – 2021, 2022 – 2025, 2026 – current
- **Declaration of interests:**
  - Provide specialist advice and policy on public health aspects of water quality including management and provision of drinking water, management and use of recycled water and use of recreational waters.
  - Contribution to WHO Drinking Water Guidelines leading to publication of background documents (e.g on toxic cyanobacteria in 2021), specialist texts and two addenda to the 4th edition of the guidelines.
  - Occasional invitations to provide keynote presentations at international meetings.
  - Published a number of scientific research journal articles.
  - Contributed to: WHO (2021) Water, sanitation, hygiene, and waste management for SARS-CoV-2, the virus that causes COVID-19, NRMMC/EPHC/NHMRC (2008) Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2). Augmentation of Drinking Water Supplies, enHealth Guidance on the Use of Rainwater Tanks and Numerous fact sheets and guidance documents for the SA Department for Health and Wellbeing on drinking water and recreational waters.
  - Membership of the program committees including for the Singapore International Water Week and Australian Water Association Annual Conference OzWater.
  - Membership of the International Water Association and Australian Water Association.
  - Membership of the Hong Kong Drinking Water Safety Advisory Committee from 2018.
  - Membership of Guideline Development Group WHO Guidelines on Recreational Water Quality Volume 1 Coastal and Fresh Water (1998-2021)
  - Chair of the enHealth Water Quality Expert Reference Panel since 2017.
  - Chair of the External Audit Panel Singapore Public Utilities Board since 2020.
  - Chair of the WHO Drinking Water Guideline Coordinating Committee.
  - Involvement in risk assessment projects with the Cooperative Research Centre for Solving Antimicrobial Resistance in Agribusiness, Food and Environments (CRC SAAFE) with Water RA and the South Australia Environment Protection Authority.

Ms Miranda Cumpston - Australian Clinical Trials Alliance, Monash University and University of Newcastle

- **Committee term:** 2019 – 2021
- **Declaration of interests (as declared at end of 2021):**
  - As part of previous role with the Australian Clinical Trials Alliance undertook activities in collaboration with NHMRC and other partners, including public advocacy in relation to the conduct and funding of clinical trials in Australia.

- Editor at Cochrane Public Health, University of Newcastle, which receives infrastructure funding from NHMRC.
- Editor of Cochrane Handbook for Systematic Reviews of Interventions and author of other publications that advocate for the use of systematic reviews in policy.
- Received Australian Government Research Training Program (RTP) Scholarship to undertake a PhD in evidence synthesis methods at the Research Methodology Division, School of Public Health and Preventive Medicine, Monash University.
- Employed by NHMRC between April and June 2018, contributing to the development of the NHMRC Guidelines for Guidelines.
- Publications of numerous journal articles.
- Guest lectures on evidence synthesis and clinical practice guideline development to Melbourne School of Professional and Continuing Education, University of Melbourne (various courses) in 2018 and 2019.

Mr Cameron Dalgleish - State Water Officer Tasmanian Department of Health

- **Committee terms:** 2019 – 2021, 2022 – 2025, 2026 – current
- **Declaration of interests:**
  - Health regulator for drinking water safety in Tasmania; administering legislation, policy and guidelines for both drinking water quality and fluoridation. A working understanding of the implementation of the ADWG framework.
  - An environmental scientist specialising in water chemistry with over 20 years' experience in the water industry. Previously worked across construction, natural resource conservation, environmental management and as a health regulator.
  - Appointments: Member of the enHealth Water Quality Expert Reference Panel, the National Recycled Water Regulators Forum and the Australian Water Association. Secretariat of the Tasmanian Fluoridation Committee.
  - Department of Health Tasmania Member Representative to Water Research Australia.
  - Has published journal articles, reports, fact sheets, guidelines and presentations at national conferences, seminars and workshops.
  - Public Servant: State Water Officer, Department of Health Tasmania.
  - Project contributor for the development of Operator Competencies in the water industry and development of a WaterVal granular media filter validation protocol, both coordinated by Water Research Australia.
  - Areas of expertise: Environmental science, water quality and chemistry, risk management, auditing, public health.
  - Holds stock market investments, and partner is a joint investor in managed fund investments. Neither have influence in the selection of shares purchased on their behalf.

Dr Daniel Deere - Independent Consultant Director Water Futures; Visiting Fellow, Water Futures, The University of New South Wales

- **Committee term:** 2019 – 2021
- **Declaration of interests (as declared at end of 2021):**
  - Consultant – Water Futures Visiting Fellow – UNSW
  - Current projects for: University of Technology Institute for Sustainable Futures 2019 – present; Monash Medical School (DHHS): 2019 – present; University of Bristol, Kathmandu University and Haramaya University (funded by UK Aid): 2020-present; University of Adelaide, (for Seqwater): 2019 – present; University of Adelaide and Australis Consulting (for Central Coast Council): 2019 – present; University of New South Wales, Monash University and Natural Logic (for Water Research Australia): 2019 – present; New Zealand Ministry of Health and Department of Internal Affairs: 2019 – present; Hastings District Council and New Zealand Ministry District Health Board: 2017 – present; Hong Kong Water Supplies Department: 2017 – present; NT Government (Power Water with Department of Local Government, Housing and

Community and Department of Health): 2018 – present; NSW Health: 2019 – present; Department of Health and Human Services, EPA and Department of Environment, Land, Water and Planning: 2019 – present; Department of Health and Human Services, EPA and Department of Environment, Land, Water and Planning: 2019 – present; University of Queensland: 2009 – present.
    - Current major unfunded projects/activities: World Health Organization Guidelines for Safe Recreational Water Environments Working Group; National Health and Medical Research Council Guidelines for Managing Risks in Recreational Water, Water Quality Advisory Committee; COVID-19 technical support for multiple agencies in Australia and internationally on an as needs basis relating to general microbiology and WASH aspects. This to date has been in the US, UK, China, HK, Australia and NZ.
    - Additional minor funded activities past and present include peer reviews, training, workshop facilitation, regulatory audits of water suppliers for health departments, contributions to research projects and specific technical assessments and validation, with the work mostly related to microbial pathogens.
    - Occasionally undertakes work for members of the Australian Water Industry as a consultant. This includes Health Departments, Water Agencies and Water Utilities and related to water quality risk assessment and management and other aspects of water quality science. This also involves Water Research Australia: Drinking water catchment source assessment tool; Hong Kong Development Bureau and Department of Health: assessment of risks from using seawater for non-potable uses; NSW Health: support for councils to implement the ADWG Framework; Power Water (Northern Territory): Catchment source water assessments to identify pollution sources; Vic DHHS: Drinking water supply risk management plan regulatory audits for water utilities (funded by the utility but undertaken for DHHS); SA Health/SA Water: Drinking water supply risk management plan regulatory audit for SA Water; Queensland Health: Advising Qld councils on implementing Health-based Targets; NSW EPA and Sydney Water: QMRA relating to biosolids application as part of guideline revision; Vic EPA: QMRA relating to recreational water guidelines; NSW IPART: Drinking water supply risk management plan regulatory audits for water utilities (funded by the utility or IPART but undertaken for IPART); WHO: Western Pacific Regional Office Water Safety Plan Training of Trainers Program for AusAID (DFAT) and UK AID.
    - Occasionally provides expert witness statements in court for the interpretation of the Australian Drinking Water Guidelines or Guidelines for Managing Risks in Recreational Water in relation to water quality protection.
    - Member of Seqwater Water Security Program - Independent Review Panel, NSW Health Cryptosporidium and Giardia Expert Panel, the Australian Water Association, the International Water Association and Water Research Australia.
    - Publications include numerous journals and technical reports and presented at international and national conferences, seminars, webinars and workshops. Focus is on providing practical guidance founded in objective, best available evidence for water quality management.

Professor Cynthia Joll (Chair 2026-2028) - Curtin Water Quality Research Centre, Curtin University

- **Committee terms:** 2019 – 2021, 2022 – 2025, 2026 – current
- **Declaration of interests:**
    - Previously Deputy Director, Curtin Water Quality Research Centre, Curtin University. The Curtin Water Quality Research Centre was a Strategic Research Alliance with the Water Corporation of WA. Member representative for Curtin University to Water Research Australia. Currently, Professor and Leader of the Curtin Water Quality Research Group.

- Chief Investigator on past ARC Linkage projects on disinfection by-products in drinking water systems, and other drinking water and wastewater projects, with partner organisations Water Corporation of WA and Water Research Australia.
- Current, past and future projects funded by water utilities on wastewater treatment, water recycling, and drinking water treatment and distribution, including formation of disinfection by-products and analysis of their concentrations in drinking water distribution systems.
- Published numerous research papers, conference publications, reports, books and book chapters on wastewater treatment, water recycling, source water quality and drinking water treatment and distribution, including disinfection by-products.
- Participation in national and international academic and industry conferences.
- Current, past and future projects funded by industry partners, government (e.g. NESP) and CSIRO on PFAS in drinking waters, wastewaters, water recycling and manufactured and waste products (e.g. for recycling purposes).
- Lectures at Curtin University on environmental chemistry, water chemistry and analytical chemistry.
- Travel support to attend research meetings of Water Research Australia where topics such as drinking water treatment and disinfection by-products have been discussed.
- Current, past and future projects funded by the water industry relating to corrosion and metal concentrations in drinking water distribution systems.

Professor Stuart Khan - Water Research Centre, The University of New South Wales; Fellow, Australian Academy of Technological Sciences and Engineering

- **Committee term:** 2019 -2021
- **Declaration of interests (as declared at end of 2021):**
  - Lectures at the University of New South Wales on topics closely related to the activities of the Water Quality Advisory Committee and the Recreational Water Quality Advisory Committee including water and wastewater quality and analysis.
  - Works closely with many Australian and international water industry participants including water utilities, health regulators, environment regulators and private consultants.
  - Committee/Advisory member of: Sydney Independent Metropolitan Water Advisory Panel; WHO – Water Quality and Technical Advisory Group 2015 – present; Water Quality Research Australia – Project Quality Review Team 2012 – present; U.S. WateReuse – Technical Advisory Committee 2015 – 2017; Gold Coast Commonwealth Games Independent Expert Panel – Water Quality and Monitoring Programme 2016 – present; the National Water Grid Advisory Body 2020 – present (The Advisory Body provides independent expert advice to the Australian Government via the Deputy Prime Minister on specific water infrastructure policy, projects and investment priorities).
  - Member of: Australian Water Association; International Water Association; Engineers Australia.
  - Honorary (unpaid) role as an adviser to the Parramatta River Catchment Group.
  - Past Committee/Advisory member of: U.S. WateReuse Foundation – Project Advisory Committee 2010 – 2014; Australian Water Recycling Centre of Excellence – Project Advisory Committee 2011 – 2014; CSIRO and NSW Environmental Trust – Project Advisory Committee 2010 – 2013; South East Queensland Urban Water Security Research Alliance – Project Advisory Committee – Purified Recycled Water Project 2008 – 2012.
  - Consultant: undertook work for members of the Australian Water Industry in relation to water quality.
  - Provided expert opinion to Water Research Australia on PFAS chemicals. This includes contribution to a current water industry fact-sheet on these chemicals and

their relevance to the water industry. In the past, made comments to the media regarding the safety and risks associated with PFAS in drinking water.
    - Journal Editorships: Associate Editor – Environmental Science – Water Research and Technology; Journal of Water Supply – Research Technology.
    - Participation in national and international academic and industry conferences.
    - Publication of numerous journal articles, reports and book chapters; also presentations at international and national conferences, seminars and workshops.
    - Recipient of research grants from government and non-government agencies – including Australian Research Council and Water Research Australia. Applications for NHMRC funding are much less frequent, but not excluded.

Professor Frederic Leusch (Chair 2019-2021) - School of Environment and Science, Griffith University

- **Committee terms:** 2019 – 2021, 2023 – 2025, 2026 – current
- **Declaration of interests:**
    - Several consultancies funded by water industry, specifically on contaminants of emerging concern.
    - ARC Linkage grants include many water utilities in Australia (including Water Research Australia).
    - Previous member of the Project Review Team for Water Research Australia, which reviews research projects submitted for Water RA funding and provide advice on suitability to Water RA's research agenda.
    - Received travel support from Water Research Australia to present on research supported by Water RA at their annual research conference.
    - Teaches on water quality issues at Griffith University and has given lectures at various institutions on water quality issues and various drinking water guidelines.
    - Previously involved on the Commonwealth Games Independent Expert Panel on water quality, providing advice on water quality and monitoring programme for the 2018 Commonwealth Games.
    - Many publications on water quality, all published in peer-reviewed journals.
    - Independent Advisory Panel Member in the Faure New Water Scheme, Cape Town, South Africa.
    - Member of the Advisory Committee on the Environmental Management of Industrial Chemicals (IChEMS Advisory Committee).

Associate Professor Susan Petterson - School of Medicine, Griffith University; Director, Water & Health Pty Ltd; Editor, Journal of Water and Health

- **Committee term:** 2019 – 2021
- **Declaration of interests (as declared at end of 2021):**
    - Associate Professor at School of Medicine, Griffith University.
    - Director of Water & Health Pty Ltd
    - Editor: Journal of Health and Water (IWA Publishing)
    - Consultant to: Viega Plumbing on opportunistic pathogens; the City of Edmonton, Canada – on recreational water; expert testimony for AGL Macquarie on opportunistic pathogens; NSW Health – in drinking water QMRA; Queensland Urban Utilities – applying QMRA to assess overflow impacts on recreational sites.
    - Advisor for WHO Water Sanitation Hygiene and Health on risk assessment and microbial aspects in water.
    - Member of the independent peer review panel (human health) for Sydney Water.
    - Member of Sydney Independent Metropolitan Water Advisory Panel
    - Peer Review of QMRA undertaken for recreational water quality at Hunter Beaches for Hunter Water.
    - Current projects for: Global Water Pathogens Project; Public Health Agency of Sweden 2012 – present; Sydney Water Corporation 2012 – present; NSW Health 2012 – present; WHO 2009 – present.

- Past projects for: Government of Alberta, Canada 2013 – 2014; INTARES EU 2011 – 2014; Water Research Australia 2011 – 2013; Swedish Water and Wastewater Association – Stockholm Water Ltd 2011.
- Publications on numerous journals and reports; also presentations at international and national conferences, seminars and workshops.
- IWES course presentation.

Mr Peter Rogers - Water and public health expert

- **Committee term:** 2022 - 2025
- **Declaration of interests (as declared at end of 2025):**
  - Former Principal Policy Development Officer – Water and wastewater portfolio, Northern Territory Department of Health

Professor Craig Simmons - Fellow, Australian Academy of Technological Sciences and Engineering; Executive Director for Maths, Chemistry, Physics and Earth Sciences at the Australian Research Council (secondment); National Centre for Groundwater Research and Training, School of the Environment, Flinders University; Adjunct Professor, The University of Western Australia

- **Committee term:** 2019 – 2021
- **Declaration of interests (as declared at end of 2021):**
  - Foundation Director at the National Centre for Groundwater Research and Training
  - Executive Director at the Australian Research Council
  - Matthew Flinders Distinguished Professor of Hydrogeology and Schultz Chair of the Environment – Flinders University; Fellow of the Australian Academy of Technological Sciences & Engineering; Adjunct Professor – The University of Western Australia.
  - Committee member of: Alternate Deputy Chair Statutory Independent Scientific Committee (IESC) on Coal Seam Gas and Large Coal Mining Development; Chair – IESC Research Subcommittee; Deputy Chair of the ATSE's Water Forum; Chair – Roundtable for Oil and Gas Projects in South Australia; Chair, Alligator Rivers Region Technical Committee; Member – Research Advisory Committee, Goyder Institute for Water Research South Australia; Member – Engineering and Medicine Roundtable on Unconventional Hydrocarbon Development, US National Academies of Sciences; Member – Agency reference Group, Office of Groundwater Impact Assessment, QLD; Member – Steering Committee, SA NRM research and Innovation Network.
  - Member of: Australian Institute of Company Directors; National Groundwater Association of the U.S.A; International Association of Hydrogeologists; American Geophysical Union; Geological Society of America; Hydrological Society of South Australia.
  - Editorial boards: Australian Journal of Water Resources; International Journal of Water Conservation Science and Engineering; International Journal of Environmental Modeling and Assessment; Groundwater; Journal of Hydrology; Vadose Zone Journal.
  - Publications of numerous journal articles, book chapters and reports; presentations at international and national conferences, seminars and workshops.
  - Honorary Professor Australian National University.

Ms Nicola Slavin – Northern Territory Department of Health

- **Committee term**: 2022-2025
- **Declaration of** interests (as declared at end of 2025):
  - Northern Territory representative on enHealth Water Quality Expert Reference Panel and the National Recycled Water Regulators Subgroup
  - Northern Territory representative on enHealth Expert Reference Panel on Aboriginal and Torres Strait Islander Environmental Health

Dr Bala Vigneswaran – New South Wales Department of Climate Change, Energy, the Environment and Water

- **Committee term**: 2022-2025
- **Declaration of interests (as declared at end of 2025):**
    - Previously served in the New South Wales regional councils in positions concerning water resources, water treatment processes and system compliance.

Dr Katrina Wall – New South Wales Department of Health

- **Committee term**: 2019-2021
- **Declaration of interests (as at end of 2021):**
    - Employed by NSW Health as Senior Project Officer in the Drinking Water Risk Management Water Unit, Environmental Health Branch since 2008. Provide water quality advice, policy and regulation for NSW.
    - Represented NSW on the enHealth Water Quality Expert Reference Panel 2016-2018, providing advice and national guidance on water quality and public health.
    - Represents NSW Health on the NSW Carp Advisory Group, 2017-current, provides advice and NSW policy position to the National Carp Control Program.
    - NSW sewage surveillance for SARS-CoV-2 steering committee member.
    - Corporate member of the International Water Association and WaterRA including participation in project advisory committees, and personal member of the Australian Water Association.
    - Member of the Project Advisory Committee to Water Research Australia project 1109 Health Based Targets guidance.
    - Published journal articles conference proceedings and reports, presented at international and national conferences, seminars and workshops.

Associate Professor Harriet Whiley – Flinders University

- **Committee term**: 2022-2025
- **Declaration of interests (as at end of 2025):**
    - Holds an indirect, non-pecuniary interest through my role as SA Branch Committee Member for the Australian Water Association (2021-2022).
    - Holds an indirect financial interest through my ongoing research collaborations with Enware, a manufacturer and distributer of commercial and industrial plumbing products.
    - Flinders University representative for Water Research Australia.
    - Numerous past, present and current research projects on water quality which have received both grant and industry funding. This includes research on biofilms, opportunistic pathogens, rainwater, plumbing materials and risk management approaches.
    - Has published in academic journals and industry magazines on topics such as lead and water quality risks.
    - Has presented at academic and industry conferences and workshops.
    - Holds an indirect, non-pecuniary interest through her role on the Legionella Management Advisory Group.
    - Deputy Director of the ARC ITTC for Biofilm Research & Innovation.

Ms Carolyn Stanford - Consumer Representative

- **Committee term**: 2019-2021
- **Declaration of interests (as at end of 2021):**
    - Consultancy fees to Stanford Marketing from Goulburn-Murray Rural WaterCorp for marketing and communication services.
    - Development of Goulburn – Murray Water publications.

- Development of various guidelines, standards, educational material or fact sheets for Coliban Water 1999 – 2005.

Dr Sonia Colville (Observer) - Department of Climate Change, Energy, the Environment and Water

- **Committee term**: 2022-2023
- **Declaration of interests (as at end of 2023):**
  - No interests declared.

Ms Yulia Cuthbertson (Observer) - Department of Climate Change, Energy, the Environment and Water

- **Committee term**: 2023-2025
- **Declaration of interests (as at end of 2025):**
  - Represents interests of the Department of Climate Change, Energy, the Environment and Water and the Water Quality team from the National Strategies and Assessments section of the Water Policy Division in particular.

Dr Nick Fletcher (Observer) – Food Standards Australia New Zealand

- **Committee term:** 2019-2021
- **Declaration of interests (as at end of 2021):**
  - Member of: Joint FAO/WHO Expert Committee on Food Additives (JECFA) advisory panel; New Zealand Environmental Protection Agency Hazardous Substances and New Organisms Committee.
  - Manager Risk Assessment Chemical Safety and Nutrition, Food Standards Australia New Zealand.
  - Senior Associate (Toxicology) Coffey Environments 2012-2013.

Dr Nobheetha Jayasekara (Observer) – Australian Industrial Chemicals Introduction Scheme

- **Committee term**: 2023-2025
- **Declaration of interests (as at end of 2025**):
  - No interests declared.

Mr Adam Lovell (Observer) – Water Services Association of Australia (WSAA)

- **Committee term**: 2019-2021, 2022-2023
- **Declaration of interests (as at end of 2023):**
  - Water Services Association of Australia (WSAA) - Executive Director
  - Global Water Research Coalition (GWRC) – Board Chair
  - The GWRC is a non-profit organisation that serves as a focal point for the global collaboration for research planning and execution on water and wastewater related issues.

Dr Kerry Nugent (Observer) – Australian Industrial Chemicals Introduction Scheme

- **Committee term:** 2022
- **Declaration of interests (as at end of 2022):**
  - Member of Government standard setting committee

Mr Marcus Walters (Observer) – Department of Agriculture, Water and the Environment

- **Committee term:** 2019-2020
- **Declaration of interests (as at 2020):**
  - No interests declared.

Mr Laurence Wilson (Observer) – National Indigenous Australians Agency

- **Committee term**: 2022-2025

- **Declaration of interests (as at end of 2025):**
  - No interests declared.